GUIDELINES FOR HANDHELD MOBILE DEVICE INTERFACE DESIGN

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ABSTRACT

While there has been much successful work in developing rules to guide the design and implementation of interfaces for desktop machines and their applications, the design of mobile device interfaces is still relatively unexplored and unproven. This paper discusses the characteristics and limitations of current mobile device interfaces, especially compared to the desktop environment. Using existing interface guidelines as a starting point, a set of practical design guidelines for mobile device interfaces is proposed.

KEYWORDS: HANDHELD, MOBILE, GUIDELINES, INTERFACE, DESIGN

INTRODUCTION

Handheld mobile devices, including personal digital assistants (PDAs) and cell phones, have become increasingly prevalent. However, while Shneiderman's "Golden Rules of Interface Design" [14] have existed for some time now, there have been no similar guidelines developed for mobile devices. This paper presents work-in-progress towards addressing this gap, and proposes a set of guidelines for mobile device interface design. The guidelines use the Golden Rules as a starting point, and are grounded in previous research on mobile device design and use.

Enable frequent users to use shortcuts
Offer informative feedback
Design dialogs to yield closure
Support internal locus of control

Table 1: Guidelines that carry over to mobile devices

INTERFACE GUIDELINES THAT CARRY OVER TO MOBILE DEVICES

Half of Shneiderman's eight interface design guidelines apply to mobile devices without explicit changes. These are shown in Table 1.

Enable Frequent Users to Use Shortcuts

As the frequency of use increases, so does a user's desires to reduce the number of interactions and to increase the pace of interaction. Because time is often more critical to a mobile device user[11]. Reducing the number of operations needed to perform regular (i.e., repetitive) tasks is a key factor in the ease of use of mobile devices.

Offer Informative Feedback

For every operator action, there should be some system feedback, such as a beep when pressing a key or an error message for an invalid input value. Such feedback should be substantial and understandable by the user. For example, the messages “HTTP404 ERROR” and “THE PAGE CAN NOT BE FOUND” may be equivalent, but the latter will most likely be of greater benefit to most users.

Design Dialogs to Yield Closure

Sequences of actions should be organized into groups with a beginning, middle, and end. Users should be given the satisfaction of accomplishment and completion, no matter whether they are using desktop computers or mobile devices.

Support Internal Locus of Control

Users want to be in charge of the system and have the system respond to their actions, rather than feeling that the system is controlling them. Systems should be designed such that users initiate actions rather respond to them. This guideline is applicable both to traditional desktop applications and mobile device applications.

Consistency
✧ The “look and feel” should be the same across multiple platforms and devices
✧ Elements of mobile interfaces such as names, color schemes, and dialog appearances should be the same as their desktop counterpart
✧ Create input/output methodologies that are device independent - avoid using methods specific to mobile platforms where possible
Reversal of actions
✧ Mobile applications should rely network connectivity as little as possible
Error prevention and simple error handling
✧ Nothing potentially harmful should be triggered by too simple an operation (e.g., power on/off)
Reduce short-term memory load
✧ Rely on recognition of function choices instead of memorization of commands
✧ Use modalities such as sound to convey information where appropriate

Table 2: Guidelines that need modification

MODIFICATIONS TO EXISTING RULES

The remaining four guidelines require modifications and/or an increased emphasis on use with mobile devices. These are summarized in Table 2, along with some practical suggestions.

Consistency

Consistency takes on an additional dimension with mobile applications: the consistency across multiple platforms and devices for the same application [2]. Users of mobile devices may need to switch between their desktop machines and different mobile devices frequently. For example, a user may want to transfer some documents from a home desktop computer to a PDA, read them while riding the subway, and call colleagues with questions. In this situation, consistency should be maintained between desktop and PDA (and possibly cell phone). Consistency can also be achieved by creating I/O methodologies that are device independent. Isokoski and Raisamo proposed a Minimal Device Independent Text Input Method that can be used consistently across devices [10].

Reversal of Actions

Allowing easy reversal of actions may be more difficult for mobile devices because of a lack of available resources and computing power [12]. Mobile devices have less memory to store the states of past events. Even if state information is offloaded to more powerful stationary computers, the greater susceptibility of wireless communications to connectivity losses makes tracking of past states more difficult [12] [8].

Error Prevention and Simple Error Handling

Preventing and handling errors on mobile interfaces are similar to those for desktop interfaces, although the need becomes more critical due to the more rapid pace of events in the mobile environment. Error prevention also needs to take the physical design of mobile devices into account. Smaller device sizes make the proximity of buttons to each other more of a potential problem.

Reduce short-term memory load

Given the limitations of a user’s short-term memory, interfaces should be designed such that very little memorization is required during the performance of tasks [2]. When in the mobile environment, a user has to potentially deal with more distractions than with a desktop computer [15]. A mobile application may not be the focal point of the user’s current activities [5], and a user may not be able to suspend his or her primary task to interact with the mobile device [3] [8]. Using alternative interaction modes such as sound can be beneficial [11].

Design for multiple and dynamic contexts
✧ Allow users to configure output to their needs and preferences (e.g., text size, brightness)
✧ Allow for single- or no-handed operation
✧ Have the application adapt itself automatically to the user’s current environment
Design for small devices
✧ Provide word selection instead of requiring text input
Design for limited and split attention
✧ Provide sound and tactile output options
Design for speed and recovery
✧ Allow applications to be stopped, started, and resumed with little or no effort
✧ Application should be up and running quickly
Design for “top-down” interaction
✧ Present high levels of information and let users decide whether or not to retrieve details
Allow for personalization
✧ Provide users the ability to change settings to their needs or liking
Design for enjoyment
Applications should be visually pleasing and fun as well as usable

Table 3: Additional guidelines for mobile interface design

ADDITIONAL GUIDELINES FOR MOBILE DEVICE DESIGN

What follows are additional guidelines specifically for mobile device interface design. Following these can be critical due to the particular characteristics of mobile devices [12] [3]. Mobile device interface design is more restrictive than desktop interface design because of relatively limited computing and communication power, smaller platform sizes, an always-changing context [15], and smaller amounts of user attention [3]. These guidelines are summarized in Table 3, along with some practical implementation suggestions.

Design for multiple and dynamic contexts

The contexts of computer applications used in the office, home, or similar settings are relatively stable. On the other hand, with mobile applications, there can be a significant number of additional people, objects, and activities vying for a user's attention aside from the application or computer itself [15]. Environmental conditions (e.g., brightness, noise levels, weather) can change depending on location, time of day, and season. The usability or appropriateness of an application can change based on these different context factors [7]. For example, in the presence of strangers, users may feel uncomfortable speaking input aloud, and certain places (e.g., libraries) might restrict the use of voice input. Small text sizes may work well under office conditions but suddenly become unreadable in bright sunshine or in dimly lit spaces. In addition, users may have one hand, or even both hands, occupied while using a mobile device [8]. Therefore, for different contexts, allowing operations with 0, 1, or 2 hands becomes extremely important to the viability of the interface [7].

One way to solve the problem of changing contexts is to implement context-awareness and self-adapting functionalities [4]. This can potentially save the user effort and frustration, and increase the usability of applications. Usability in a dynamic environment might also be improved by devices that derive input indirectly from the user. Schmidt discussed a vision of mobile computing where devices can "see, hear, and feel." [13].

Design for Small Devices

As technology continues to advance, mobile platforms will continue to shrink in size and include items such as bracelets, rings, earrings, buttons, and key chains. New or modified interaction techniques may be necessary to overcome the physical limitations. Speech input is a viable alternative for devices too small for buttons. Sound can also be used for output, taking the place of text or graphics. Holland and Morse investigated an audio interface for a navigation system that leaves a user's eyes and hands free for other purposes [5].

Design for Limited and Split Attention

Users of mobile devices often need to focus on more than one task [8]. A mobile application may not be the focal point of the user's current activities [5]. Mobile devices that demand too much attention may distract users from more important tasks. Interfaces for mobile devices need to be designed to require as little attention as possible [11]. Sometimes this can be accomplished by designing for hands-free interaction or even eyes-free interaction. According to Gorlenko [3], eye-free interaction provides the greatest freedom of movement during interaction, as visual attention constrains body movement. When possible, it might work better to use sound or tactile output to present information instead of visual displays [11]. Pascoe, Ryan, and Morse developed a personal digital assistant (PDA) application, which allowed the user to count the number of bites taken from tree leaves without looking away from the animal.

Design for speed and recovery

For mobile devices and applications, time constraints need to be taken into account in initial application availability and recovery speed. When time is critical, waiting a few minutes for an application to start may not be in the user's best interest. Given the different contexts under which mobile devices are used, users may need to quickly change or access functions or applications [11]. When such situations rise, a user would need to quickly and securely save any work already performed and resume it later without any loss.

Design for "Top-Down" Interaction

Mobile devices with small screens have limitations on the amount of information that they can present at one time. Reading large amounts of information from such devices can require large amounts of scrolling and focused concentration. To reduce distraction, interactions, and potential information overload, a better way of presenting information might be through multilevel or hierarchical mechanisms [1]. For example, a mobile worker may not need or want the entire contents of a message. However, they may wish to receive a notification that a message is available, along with an indication of how important it is. That way, the worker can make their own decision, whether or not to stop their primary task to access the contents of the message.

Allow for personalization

Mobile devices, by their nature, are more personal. While traditional telephones and desktop computers can many times be shared among different users, a mobile device is usually carried and used by only one person. Therefore it is more likely that a user of mobile applications will personalize the device and its applications to his or her preferences. Different users have different usage patterns, preferences, and skill levels. So it is important to allow for variations among users. For example, when visibility is good, it is reasonable to show more text on a screen; and while in a dark environment, bigger fonts might allow better readability. But the interface design should not exclude the possibility that some users may always prefer larger fonts regardless of the lighting conditions

Design for Enjoyment

While functionality and usability are keys to mobile application success, other factors are also influential. Aesthetics is also part of designing an overall enjoyable user experience with mobile devices. Karlsson and Djabri have begun to investigate "aesthetics in use"[6], which they define as dynamic interaction that invokes a positive affective response from the user. In addition, color and its manipulation are important considerations for visual interfaces. Shneiderman gave some interface color use guidelines that can generally be carried over to mobile devices [14], although some of the effects of color may be different on smaller screens. If functionality and usability are equal, an application or device will stand out if it is attractive in some way. Donald Norman, after years of stressing product design that focuses squarely on usability, realizes that emotion plays a large part in our interaction with objects [9].

CONCLUSION

This paper has presented a first attempt at a set of guidelines for the design of handheld mobile device interfaces. These guidelines are based on traditional guidelines for desktop user interfaces and published research with mobile devices and applications. These guidelines should be useful to practitioners who develop mobile applications, and to HCI researchers working with mobile interface design and usability. Our unique contributions are that we propose a complete set of guidelines for mobile interface design, and we also draw certain emphasis on some interesting mobile usability issues.

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